Inventor: HUI et al.
Docket: 1 12364.27USUI
Title: 1/UM POWER TRACKING TECHNIQUE FOR SOLAR PANE
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Ac: 1.1ichael D. Schumann (Reg. No. 30,422)
Phon; No.: 612.336.4638
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 $d_1 T_S < t < d T_S$

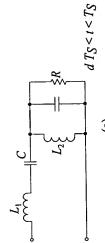
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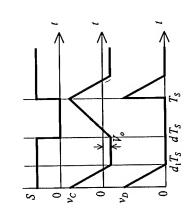
Converter

Solar panel r_{g}

28

1000521 . IZOHO1





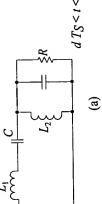


Fig. 1 Equivalent circuit of a solar panel connecting to a converter.

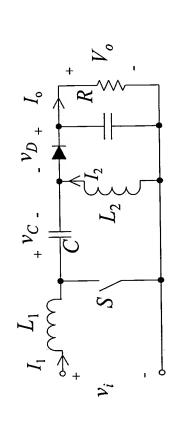


Fig. 2 SEPIC converter circuit.

Fig. 3 Operating principle. (a) Topology sequence. (b) Theoretical waveforms of νC and νD .

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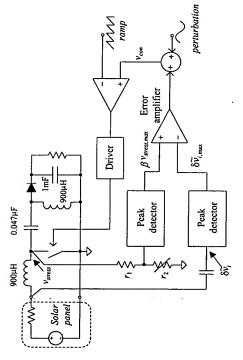


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Attorney Michael D. Schumann (Reg. No. 30,422) Attorney Michael I Phone No.: 012.336.4638 Sheet 2 of 13

16 8 4 72 9 (a) $P_{lamp} = 900W$ $P_{lamp} = 700W$ $P_{lamp} = 500W$ $P_{lamp} = 600W$ $P_{lamp} = 400W$ ထ် 9 i 1.2 0.8 9.0 0.4 0.2

120 ۲. ن --- 700W ---- 500W ---- 500W W006-8 8 9 9 6 8 P_0^{14} 6 œ ဖ

Fig. 6 Solar panel characteristics at different $P_{lamp\cdot}$ (a) i_{g} versus v_{g} . (b) P_{o} versus rį.



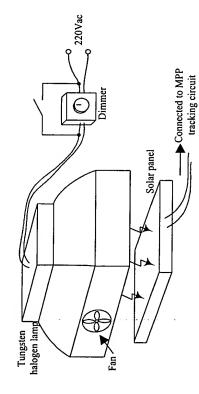


Fig. 4 Block diagram of proposed MPP tracking method.

Fig. 5 Experimental setup for the solar panel.

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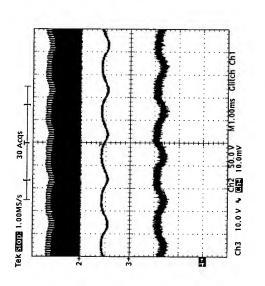


Fig. 8 Experimental waveforms of the SEPIC converter. Ch2: switch voltage stress, 50V/div; Ch3: input voltage, 10V/div; Ch4: input current, 0.5A/div.

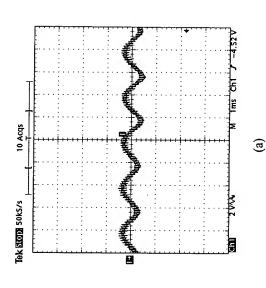
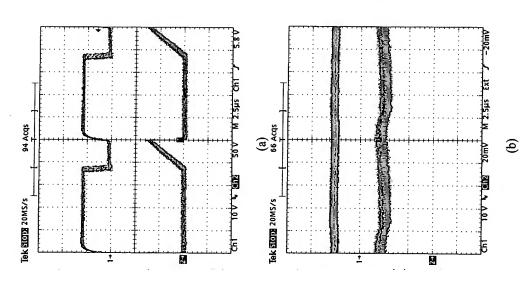


Fig. 7 Detailed experimental waveforms of the SEPIC converter. (a) Ch1: gate signal, 10V/div; Ch2: switch voltage stress, 50V/div. (b) Ch1: input voltage, 10V/div; Ch2: input current, 0.5A/div.





16 Acqs

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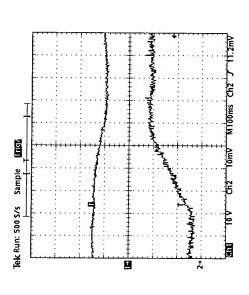


Fig. 10 Transient waveforms of the SEPIC converter subject to *Plamp* changed from 500W to 900W. Ch1: input voltage, 10V/div. Ch2: input current, 0.5A/div.

5 Acqs

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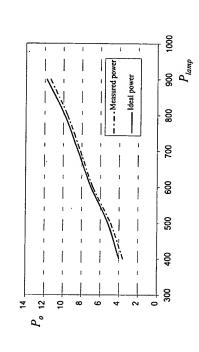


Fig. 11 Comparison of maximum solar panel output power using proposed method and the ideal ones in Fig. 6(b), under different Plamp.

Fig. 9 Waveform of $\delta \tilde{\nu}_i$ with respect to different value of \mathfrak{R} . (a) $\mathfrak{R}=0.02$. (b) $\mathfrak{R}=0.05$. (c) $\mathfrak{R}=0.1$.

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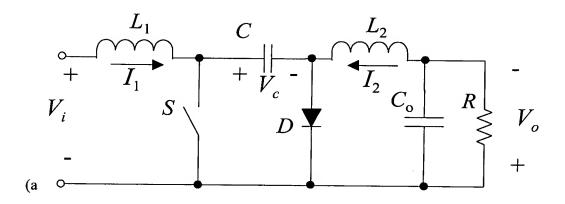
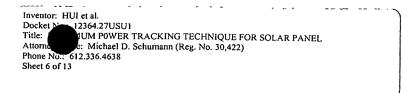


Fig. 12 Circuit diagram of the Cuk converter.



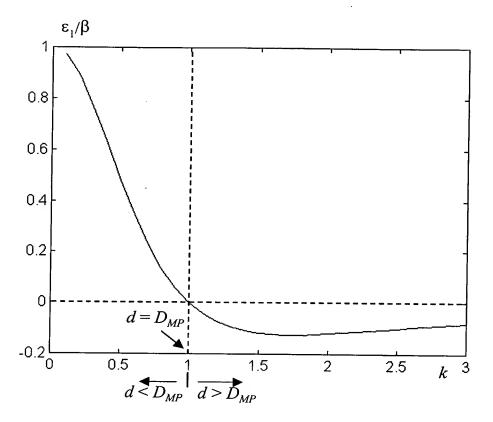


Fig. 13 Relationships between ε_1/β and k.

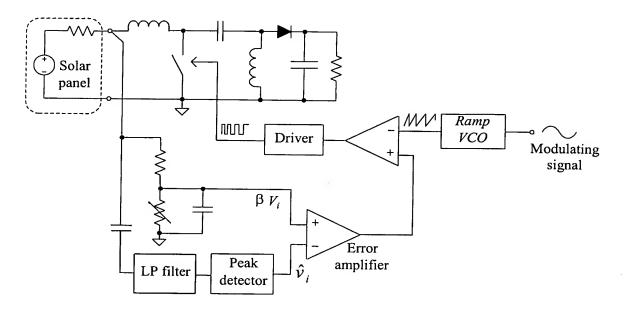
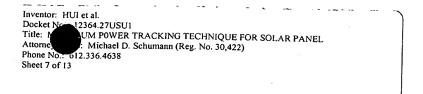


Fig. 14 The proposed MPP tracking method.



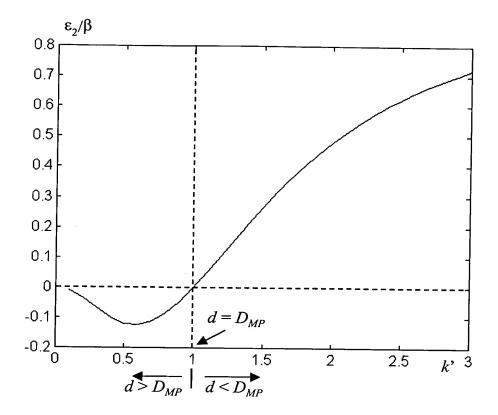


Fig. 15 Relationships between ε_2/β and k'.

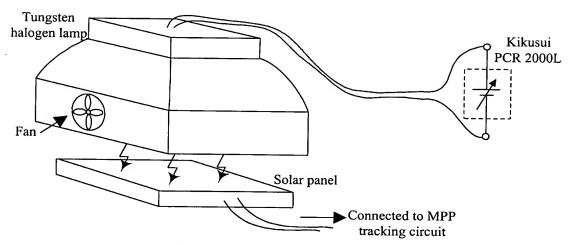


Fig. 16 Experimental setup for studying the proposed MPP tracking technique.

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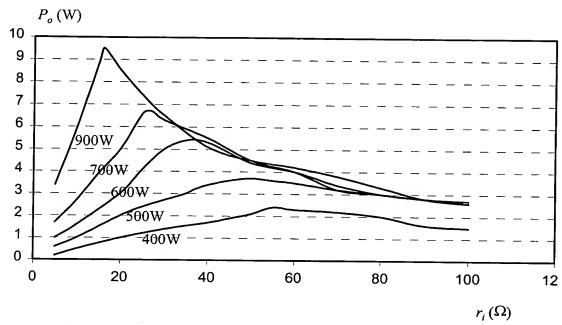
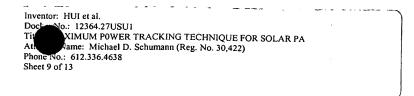
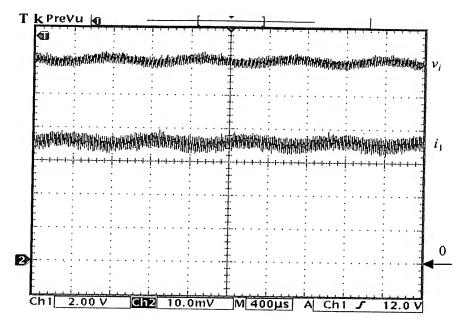
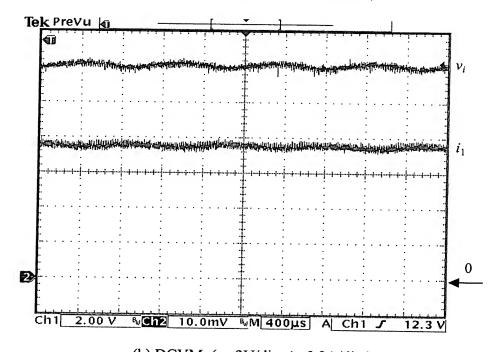


Fig. 17. $P_o - r_i$ characteristics of the solar panel at different P_{lamp} .



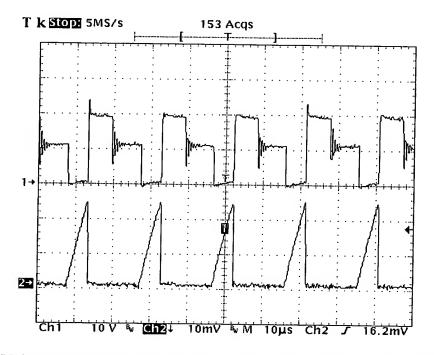


(a) DICM. $(v_i: 2V/\text{div. } i_1: 0.2A/\text{div.})$

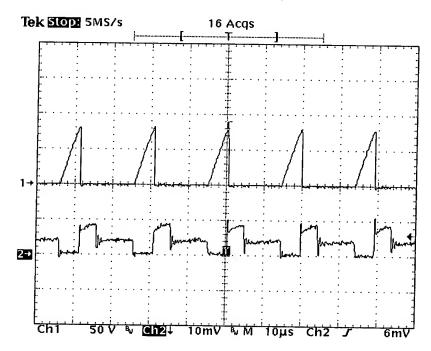


(b) DCVM. (v_i : 2V/div. i_1 : 0.2A/div.) Fig.18. Experimental waveforms of v_i and i_1 of the two SEPIC prototypes at the MPP when P_{lamp} equals 900W.

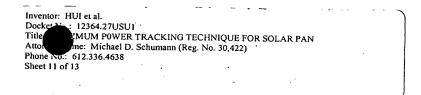
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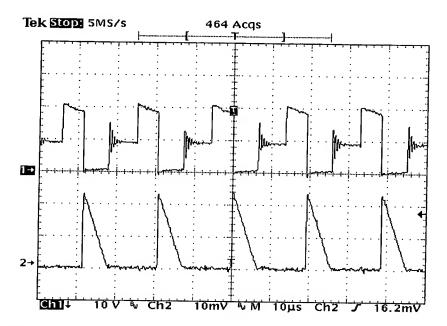


(a) Voltage and current stress on S in DICM. (Ch1: 10V/div. Ch2: 2A/div.)

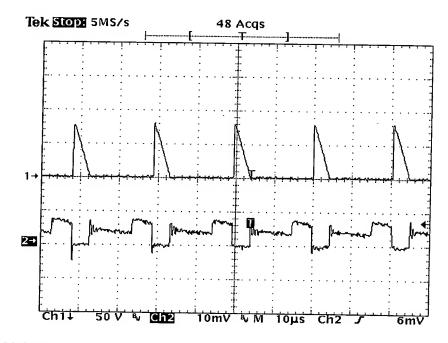


(a) Voltage and current stress on S in DCVM. (Ch1: 50V/div. Ch2: 2A/div.)





(c) Voltage and current stress on D in DICM. (Ch1: 10V/div. Ch2: 2A/div.)



(d) Voltage and current stress on D in DCVM. (Ch1: 50V/div. Ch2: 2A/div.)

Fig. 19. Experimental voltage and current stresses on S and D. (Timebase: $10\mu s/div$)

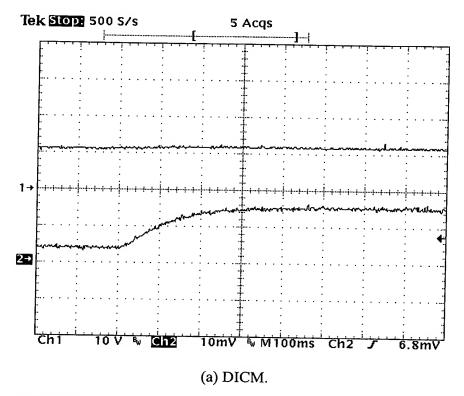
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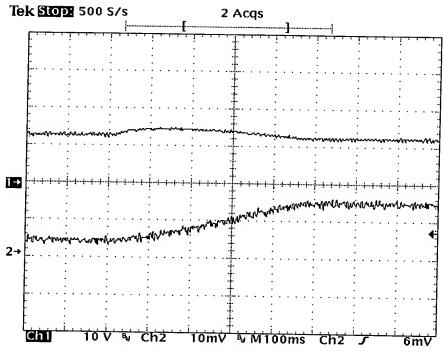
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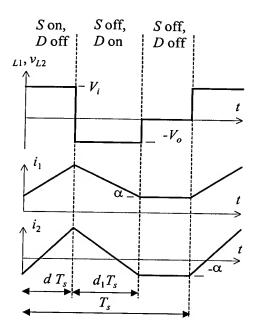
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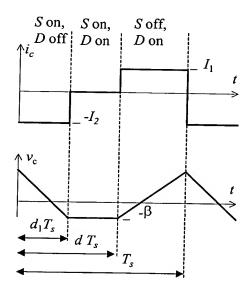


(b) DCVM. Fig. 20. Experimental waveforms of the SEPIC converters when P_{lamp} is subject to a change from 400W to 900W. (Ch1: V_i , 10V/div. Ch2: I_1 , 0.5A/div.)

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(a) Voltage and current waveforms of L_1 and L_2 in DICM.



(b) Current and voltage waveforms of C in DCVM.

Fig. 21 Key waveforms of SEPIC and Cuk converter.